Today's Fukushima nuclear power plant

Report on Inspection Tour of the Fukushima Daiichi Nuclear Power Station

Co-representatives of the Physicians Against Nuclear War

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On July 22, 2017, the video revealing the fuel debris accumulated in the containment vessel of Unit 3 of the Fukushima Daiichi Nuclear Power Station was broadcast for the first time. According to the roadmap to the decommissioning of the nuclear reactors of the nuclear power station, the plan will take as long as 40 years to complete, but the process of ascertaining the current state of the nuclear reactors has just begun. We were afforded an opportunity to participate in an inspection tour of the Fukushima Daiichi and Daini Nuclear Power Stations on June 8.

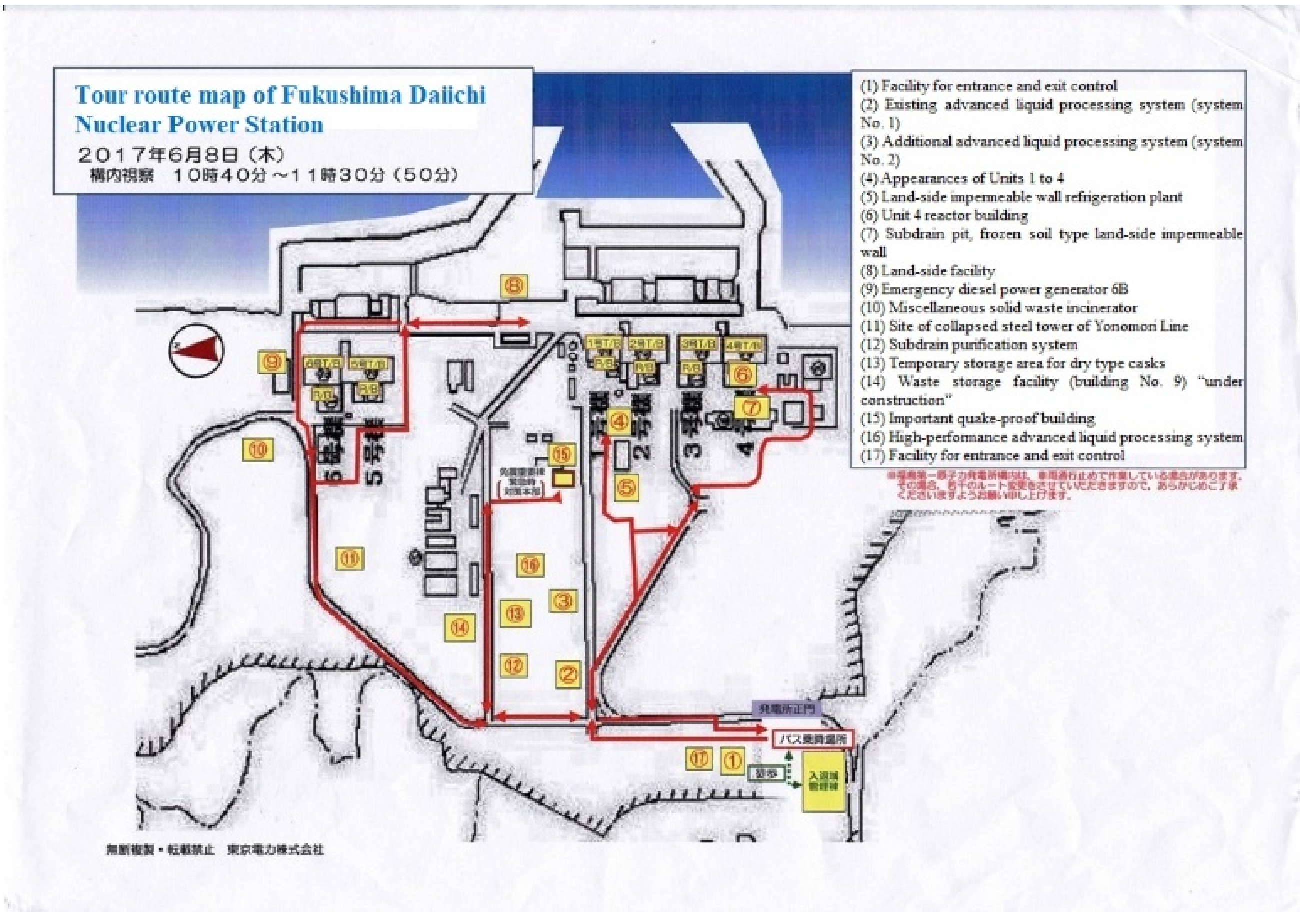
Heading for the Fukushima Daiichi Nuclear Power Station

J-Village was the place for gathering for past inspection tours of the Fukushima Nuclear Power Stations, but the former Energy Kan, which is situated several kilometers north from the Fukushima Daini Nuclear Power Station, has been used instead of J-Village since December 2016. We received a briefing on the current state of the Fukushima Daiichi Nuclear Power Station from Tokyo Electric Power Company (TEPCO) at the former Energy Kan, and then headed north on Route 6 for the Fukushima Daiichi Nuclear Power Station located about 10 kilometers away.

Tomioka-machi, where the former Energy Kan is situated, was excluded from the list of the difficult-to-return zones, and a nearby supermarket reopened in March. We drove about 2 kilometers from the town and entered a difficult-to-return zone. People could use the national road passing through the zone but could not enter or visit houses lined along it. The entrances of these houses were closed with accordion type barricades. Some drug stores, supermarkets, and restaurants were left as they had suffered damage from the earthquake and tsunami. At a used car dealer, the used cars for sale displayed at that time were abandoned, covered with dust. The surrounding scenery totally changed. In an unrestricted zone, farmland was well-maintained; the entire land of the difficult-to-return zone, on the other hand, was overgrown with weeds, and areas assumed to be paddy fields before had no trace of what they had been. Not only weeds but also tree grew considerably tall. Signboards were posted in places, saying “Beware of wild boar.” On vacant lots, we saw huge stacks of black flexible intermediate bulk bags containing decontaminated waste. We drove for a little while and came to Okuma-machi. This town was also a difficult-to-return zone, where the radiation reading on our dosimeter was 2.69 µSv. We further went up north and came to an intersection with a road sign that guided us to turn to the right to the Fukushima Daiichi Nuclear Power Station. The radiation reading on our dosimeter there was close to 10 µSv. The guide explained to us that the area was a hot spot.

Contaminated water treatment

We received an identification check and body search using a metal detector at the facility for entrance and exit control of the Fukushima Daiichi Nuclear Power Station. We were prohibited from bringing cameras and mobile phones provided with a camera function into the nuclear power station. Each visitor was given a



Tour route: We moved from the facility for entrance and exit control shown in the lower right area of the map to the sea side, observed Units 1 to 4, returned to the bus terminal, moved to the left sea side, and observed Units 5 and 6.

personal dosimeter. We were about to step into an area with mSv-level radiation from the areas with µSv-level radiation we had just driven through.

We got on a minibus for touring, and the tour began. We first saw many tanks ahead, in which contaminated water was stored. At present, about 900 tanks for storing contaminated water are installed. In earlier days, bolt-clamped flanging type tanks were used because of a shortage of tanks of appropriate types. These flanging type tanks were later replaced with welded type ones, which have been used to date, due to leakage problems. However, TEPCO staff told us that space for installing additional tanks will be no longer available in several years.

Tanks storing contaminated waters

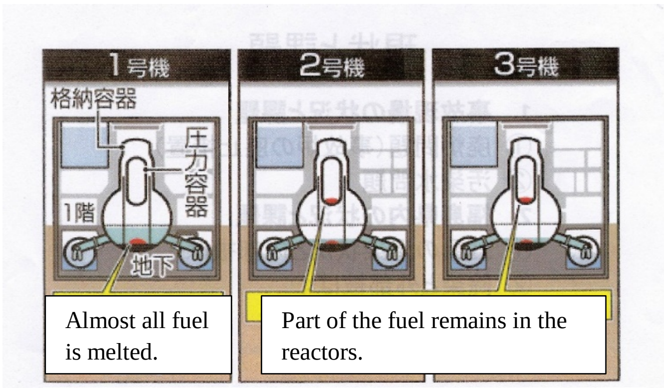
Groundwater flows through two different paths; rainwater that falls on the site of the nuclear power station penetrates into the ground and flows through the shallow layer and through the deep layer in the Abukuma Mountains. Measures that have been taken against groundwater include the covering of the ground surface with asphalt to prevent rainwater from penetrating into the ground, the drilling of wells called groundwater bypasses in the mountain-side ground, the reuse of existing subdrains, which are also wells, and the construction of impermeable walls on the sea side to shut out seawater. Underground frozen soil walls are under construction around the buildings, and the construction of the frozen soil walls on the sea side was completed in November 2016. At present, the mountain-side walls are being frozen.

In the past, 400 tons of groundwater flowed into the site every day, but the volume of groundwater has been reduced to 200 tons with the aid of the abovementioned measures. The contaminated water in the buildings is pumped up at a rate of 600 tons a day, and the contaminated water in the buildings is now reduced to 52,000 tons from the initial volume of 100,000 tons. Six hundred tons of contaminated water pumped up are treated by cesium adsorption systems (KURION, SARRY) to reduce radioactive cesium to about 1/50,000. The treated contaminated water then flows through a desalination system, which separates it into 40% of fresh water and 60% of concentrated salt water. The 240 tons of fresh water produced a day are used to cool the reactors, and the remaining 360 tons of concentrated salt water are further treated by a strontium treatment system and by an advanced liquid processing system (ALPS). At present, about 210,000 tons of concentrated salt water are yet to be treated, and about 750,000 tons of concentrated salt water have already been treated by the ALPS and no longer contain nuclides except for tritium. This tritium-containing water increases by 10,000 tons a month. The other day, TEPCO mentioned the discharge of this tritium-containing water into the ocean and was harshly criticized.

Tragic reactor buildings

A brook runs along the road leading to the reactor buildings. The levees are covered with shotcrete or asphalt to prevent the scattering of radioactivity-containing dust or the penetration of rainwater.

Unit 1 loomed up before us. Although we had seen its photos and videos over and over again, we were really shocked by how seriously it was devastated. Unit 1 was temporarily covered but is uncovered to remove spent nuclear fuel, and rubble is cleared away. Around the building are poles for water sprinkling during rubble removal work. TEPCO staff said that they will install windshield nets, start rubble removal, and, upon the completion of this work, by which the water surface of the fuel pool will become visible, fabricate fuel removal equipment to remove fuel.



Imaginary diagram of the current reactors: It is conceived that Units 1 to 3 have caused a meltdown, and the fuel has melted the bottom of the pressure vessel and formed debris on the bottom of the containment vessel.

Unit 2 escaped being exploded and looked unchanged from what had been before the disaster, but it melted down because of the cooling system's failure to operate. A pre-clean room is prepared also for Unit 2 to dismantle its top floor for the purpose of removing spent nuclear fuel.

Unit 1

A gray structure is constructed on the top of the building of Unit 3. This is the foundation of the equipment to be used to remove spent nuclear fuel, which has been fabricated since January and will be completed in a dome-shaped structure. The spent nuclear fuel will be removed by unattended remote operation. There are 566 spent nuclear fuel rods in Unit 3.

Unit 4 was shut down for regular inspection at the time of the disaster. Thus, there was no nuclear fuel in the reactor, and 1535 spent nuclear fuel rods were laid in the fuel pool. A white structure that reaches the top floor is additionally constructed beside the unit to remove the spent nuclear fuel rods. Since the fuel pool was left in an extremely unstable state by the earthquake, the additional structure was designed to bear the entire weight of the fuel pool, and all of the spent nuclear fuel rods were transferred from the fuel pool to the common-use pool over a year.

Unit 2

As described thus far, the removal of the spent nuclear fuel rods from the fuel pools of Units 1 to 3 is in progress and scheduled to be completed by 2021. After that, the removal of the fuel debris in the reactors will take place, and it is necessary to consider how to remove it as soon as possible.

TEPCO is endeavoring to determine the procedure for removing the fuel debris from each unit by the end of June 2017, but as mentioned in the beginning of this report, the company has just ascertained part of the state of the fuel debris in Unit 3, and nobody can envision how things will turn out.

Sea-side area

The minibus ran over the hill and then headed from the south end for the sea-side area 10 meters above sea level. TEPCO staff said that the radiation dose of the ground there dropped from about 100 µSv recorded after the disaster to 6.2 µSv as a result of mortar spraying. Thus, workers can carry out operations with only masks, caps, and workwear on, except in the areas around the nuclear reactors. We saw “17 m” marked on the side wall of a building, which indicated that the seawater surged to that level by tsunami. Behind Unit 4 is the common-use pool accommodating 6,800 spent nuclear fuel rods, including ones removed from the fuel pool of the unit, and almost full. TEPCO staff told us that these spent nuclear fuel rods will be placed and stored in cylinder-like containers called dry casks from the oldest ones.

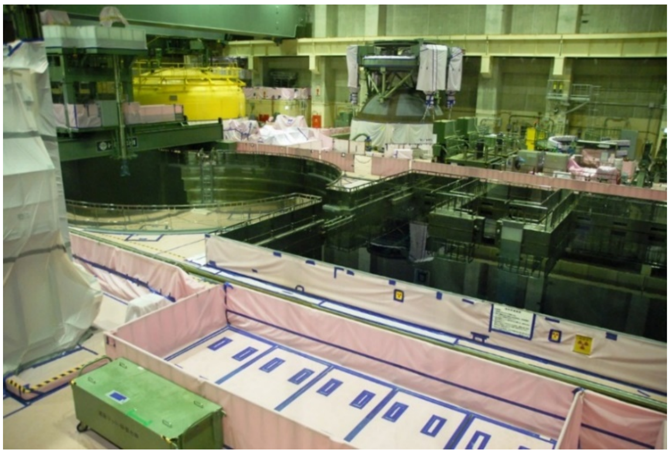
To observe Units 5 and 6 next, we returned to the hill and moved from the north end to the sea side. Units 5 and 6 are located in Futaba-machi. The tetrapods on the quay are destroyed. The tanks installed on the sea are also left destroyed by tsunami. The breakwaters are constructed in inverted V shape, and a floating island lies in between. This is the very large floating structure, which was introduced after the disaster to collect contaminated water and successfully accommodated 8,000 tons of contaminated water. Today, seabirds inhibit there, but TEPCO staff said that they are considering how to handle and remove it because cracks were found in the bottom. At the very end of the levee stands a lighthouse equipped with a radiation monitor. Steel pipes are embedded along the coast and form the sea-side impermeable walls stretching for 600 meters to shut out the seawater. The orange object along the levee is the curtain-like silt fence that functions to keep contaminated water in. Needless to say, the seawater is replaced by the coming and going of the tide.

The minibus was approaching the turbine building of Unit 5. The radiation reading there was 1.2 µSv. Units 5 and 6 survived the disaster thanks to nothing but a coincidence of lucky events. At that time, both units were in the process of regular inspection, and the reactors were inactive at cold temperature. When the earthquake occurred, both units lost the external power supply as Units 1 to 4 did, and the emergency diesel power generators automatically started to operate. Soon after that, tsunami surged and made the emergency diesel power generator for Unit 5 inoperable, but only the emergency diesel power generator for Unit 6 could continue operating. What is more, the backup storage batteries for Unit 5 narrowly escaped being destroyed, luckily avoiding a station blackout. The unit had a very narrow escape from an accident.

Fukushima Daini Nuclear Power Station

On the afternoon of the day, we toured the Fukushima Daini Nuclear Power Station. The nuclear power station is situated about 12 kilometers down south from the Fukushima Daiichi Nuclear Power Station and on the border between Naraha-machi and Hirono-machi.

The Fukushima Daini Nuclear Power Station operates Units 1 and 2 in Naraha-machi and Units 3 and 4 in Tomioka-machi. Each unit is capable of generating 1.10 million kilowatts per hour. The moment the earthquake occurred, Units 1 to 4 were operated at the rated output, and all of the units were automatically shut down due to “high earthquake acceleration” attributable to the earthquake.



Upper part of a nuclear reactor

Below a pressure vessel.

The Fukushima Daini Nuclear Power Station consequently got damaged by the earthquake and tsunami like the Fukushima Daiichi Nuclear Power Station did, but succeeded in a cold shutdown of all units without reactor core damage. TEPCO staff said that the reason the nuclear power station survived the disaster were that electric power was still supplied from the outside to the work building standing on the hill after the earthquake and tsunami, so that the central control room could, therefore, maintain the monitoring function and the reactors could be cooled down. They also said that all of the seawater heat exchanger pump buildings were attacked by the seawater and stopped operation, but only one narrowly escaped being destroyed; systems that did not require the aid of seawater pumps, such as reactor core isolation cooling and condensate supply water systems, were flexibly used to cool the inside of the pressure vessels and the containment vessels; and in concurrence with these lucky events, the replacement of the damaged motors of the seawater heat exchanger pumps and efforts by station staff to lay temporary cables from the work building restored the seawater heat exchanger pumps, making it possible to remove heat and thereby achieve the cold shutdown of the units. They mentioned, however, that the inside pressure of the pressure vessels rose close to the limit and a serious consequence would have ensued if the actions were a little delayed.

Then, we changed our clothes into Tybek protective suits (coveralls) and wore socks, gloves, a helmet, and goggles, and observed the spent nuclear fuel pool on the top floor. Following this observation, we entered a nuclear reactor containment vessel and viewed the pressure vessel from immediately below its bottom. The containment vessel, the structure of which is the same as the containment vessels of the Fukushima Daiichi Nuclear Power Station, contained diverse devices in a complicated manner. We could easily imagine how hard it is to deal with serious situation resulting from the wreckage of these devices and the melted-down fuel debris.

The radiation reading on the dosimeter was 0.01 mSv after the tour of the controlled areas inside the premises of the Fukushima Daini Nuclear Power Station. The radiation level in the Fukushima Daiichi Nuclear Power Station was lower than this value because we toured there on the minibus.

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